methods known in the art (Pangal et al., Appl. Phys. Lett. **75** 2091-2093 (1999)). A 120 nm thick capping layer of silicon nitride is then deposited onto the *a*-Si:H film by plasma-enhanced chemical vapor deposition. The silicon nitride layer is then patterned by wet etching. The structure can then be subjected to 100-300 eV A^+ and/or H^+ ion bombardment at an oblique angle for 1-2 minutes at a pressure of 1.0 mtorr. Crystallization may be then carried out by annealing the *a*-Si:H film under N_2 at 600°C for about 4 hours. Monitoring of crystal growth is carried out using UV reflectance measurement. After crystallization, the silicon nitride capping layer is removed using dilute HF. The final structure will contain biaxially oriented crystalline silicon in the regions exposed to the ion bombardment and amorphous silicon in the regions capped by the silicon nitride layer.

While specific embodiments of the process of the invention have been illustrated and described for carrying out the invention, modifications and changes of the apparatus, parameters, materials, etc. used in the process will become apparent to those skilled in the art, and it is intended to cover in the appended claims all such modifications and changes which come within the scope of the invention.

Having thus described the invention what is claimed is:

1. A method of increasing the extent of a desired biaxial orientation of a previously formed non-single-crystal structure comprising the steps of:

(a) contacting said structure with an oblique particle beam thereby forming in said structure a nucleating surface having increased desired biaxial orientation; and

(b) depositing a layer onto said previously formed structure, which layer is capable of attaining a biaxial orientation in registry with said nucleating surface.

2. A method of increasing the extent of a desired biaxial orientation of a previously formed non-single-crystal structure comprising contacting said structure with an oblique particle beam thereby forming in said structure a nucleating surface having increased desired biaxial orientation; wherein the energy level of said oblique particle beam is from about 10 eV to about 20,000 eV.

3. The method of claim 2, wherein said nucleating surface is capable of promoting epitaxial crystal growth.

4. The method of claim 3, further comprising the step of epitaxially growing a crystalline formation using said nucleating surface to promote the epitaxial growth.

5. The method of claim 2, wherein said structure comprises a lower substrate layer and an upper layer thereon, said structure oriented such that said oblique particle beam contacts said upper layer.

6. The method of claim 2, further comprising the step of depositing an orientation-transmitting layer adjacent said nucleating surface, whereby said orientation-transmitting layer is biaxially oriented in registry with said nucleating surface.

7. The method of claim 6, wherein said step of depositing an orientation-transmitting layer is carried out subsequent to said contacting step.

8. The method of claim 6, wherein said method comprises a plurality of steps of depositing an orientation-transmitting layer.

9. The method of claim 2, wherein the region of said structure contacted by said oblique particle beam is amorphous or polycrystalline.

10. The method of claim 9, wherein the composition of said amorphous or polycrystalline region is selected from the group consisting of CeO_2, Ni, MgO, Si, silicon oxide, zirconia, yttria stabilized zirconia, Y_2O_3, strontium titanate, titanium nitride, Pr_6O_{11}, Nb, and Mo.

11. The method of claim 2, wherein said oblique particle beam comprises particles selected from the group consisting of charged atoms, uncharged atoms, charged molecules and uncharged molecules.

12. The method of claim 2, wherein said oblique particle beam is directed toward said structure at an angle of incidence of from about 15° to about 85°.

13. The method of claim 12, wherein said oblique particle beam is directed toward said structure at an angle of incidence of from about 30° to about 80°.

14. The method of claim 12, wherein said oblique particle beam is directed toward said structure at an angle of incidence of from about 40° to about 70°.

15. The method of claim 12, wherein said oblique particle beam is directed toward said structure at an angle of incidence of from about 45° to about 65°.

16. The method of claim 2, wherein said step of contacting comprises bombarding said structure with said particle beam at an energy of from about 10 eV to about 5,000 eV.

17. The method of claim 2, wherein particles from said oblique particle beam are implanted into said structure.

18. The method of claim 2, wherein said particles are selected from the group consisting of a noble gas, a component of said structure, oxygen, nitrogen, an atom to be implanted into said structure, and a molecule to be implanted into said structure.

19. The method of claim 2, wherein a thickness of said nucleating surface ranges from about 1 monolayer to about 100 nm.

Sub B4

20. A method of growing a biaxially oriented crystalline formation comprising the steps of:
(a) contacting an orientable structure with an oblique particle beam, thereby forming in said structure a nucleating surface having increased biaxial orientation; and
(b) epitaxially growing said crystalline formation using said nucleating surface to promote the epitaxial growth.

21. The method of claim 20 wherein said nucleating surface is adjacent one or more orientation-transmitting layers biaxially oriented in registry with said nucleating surface, and said epitaxial growth originates adjacent at least one of said orientation-transmitting layers.

22. The method of claim 21, wherein the composition of at least one of said one or more orientation-transmitting layers is selected from the group consisting of silicon, silicon oxide, cerium oxide, zirconia, yttria stabilized zirconia, Y_2O_3, magnesium oxide, strontium titanate, titanium nitride, Pr_6O_{11}, Nb, Ni, and Mo.

Sub A7

23. The method of claim 20 wherein said step of epitaxially growing a crystalline lattice comprises depositing a crystallizable layer onto said structure whereby said nucleating surface promotes the epitaxial crystal growth in said crystallizable layer.

24. The method of claim 23, wherein said depositing is carried out using a method selected from the group consisting of chemical vapor deposition, plasma enhanced chemical vapor deposition, physical vapor deposition, laser ablation, laser deposition, sputtering, metal organic deposition, spray pyrolysis, spin coating, web coating, evaporation, metal organic chemical vapor deposition, and electron beam evaporation.

Sub B5

25. The method of claim 23, wherein the composition of said crystallizable layer is selected from the group consisting of $REBa_2Cu_3O_{7-\delta}$ (where RE is a rare earth or yttrium, and δ is greater than 0 and less than 0.5), Bi-Sr-Ca-Cu-O, Tl-Ba-Ca-Cu-O, $SrTiO_3$, Y_2O_3, RuO_2, ZrO_2, SiO_2, yttria-stabilized zirconia (YSZ), CeO_2, Al_2O_3, Si, Ge, InP, GaSb, InSb, GaAs, InAs, (In,Ga)As, CdS, $LaMnO_3$, Fe, NiO, Co, Ni, SiC, TiN, diamond, diamond-like coatings, ZnO, and lead-zirconite-titanate.

SUB A3

~~26. The method of claim 26, wherein said RE is yttrium.~~

27. The method of claim 23, wherein the composition of said crystallizable layer consists of $REZ_2Cu_3O_{7-\delta}$, where RE is a rare earth or yttrium, Z is an alkaline earth element, and δ is greater than 0 and less than 0.5.

28. The method of claim 20 wherein said step of epitaxially growing a crystalline lattice comprises epitaxially growing a crystalline formation beneath said nucleating surface of said structure whereby said nucleating surface promotes the epitaxial crystal growth of said crystalline formation.

29. The method of claim 28, wherein said step of epitaxially growing a crystalline formation within the body of said structure is carried out by annealing said structure.

Sub B6

30. The method of claim 28, wherein the composition within the body of said structure is selected from the group consisting of $REZ_2Cu_3O_{7-\delta}$ (where RE is a rare earth or yttrium, Z is an alkaline earth element, and δ is greater than 0 and less than 0.5), Bi-Sr-Ca-Cu-O, Tl-Ba-Ca-Cu-O, $SrTiO_3$, Y_2O_3, RuO_2, ZrO_2, SiO_2, yttria-stabilized zirconia (YSZ), CeO_2, Al_2O_3, Si, Ge, InP, GaSb, InSb, GaAs, InAs, (In,Ga)As, CdS, $LaMnO_3$, Fe, NiO, Co, Ni, SiC, TiN, diamond and diamond-like coatings, ZnO, and lead-zirconite-titanate.

31. The method of claim 30, wherein said step of epitaxially growing a crystalline lattice is followed by a step of removing said nucleating surface.

32. A method of crystal growth comprising the step of epitaxially growing a crystalline lattice nucleated by a biaxially oriented portion of a structure, wherein said biaxially oriented portion is formed by contacting said structure with an oblique particle beam.

33. A method of increasing the extent of a desired biaxial orientation of a previously formed non-single-crystal structure comprising contacting said structure with an oblique particle beam thereby forming in said structure a nucleating surface having increased desired biaxial orientation, wherein said structure is selected from the group consisting of metal oxides, metal carbides, metal nitrides, metal borides, metal sulfides, metal chalcogenides, metal halides mixed metals, mixed metal oxides, mixed metal carbides, mixed metal nitrides, mixed metal borides, mixed metal sulfides, mixed metal chalcogenides, mixed metal halides, rare earths, rare earth oxides, rare earth carbides, rare earth nitrides, rare earth borides, rare earth sulfides, rare earth chalcogenides, rare earth halides, alkaline earths, alkaline earth oxides, alkaline earth carbides, alkaline earth nitrides, alkaline earth borides, alkaline earth sulfides, alkaline earth chalcogenides, alkaline earth halides, semiconductors, semiconductor oxides, semiconductor nitrides, semiconductor carbides, semiconductor borides, semiconductor sulfides, semiconductor chalcogenides, semiconductor halides, and organic polymers.

34. An at least partially crystalline structure comprising:

(a) a nucleating surface formed by contacting a previously formed non-single-crystal structure with an oblique particle beam;

(b) from 0 to 10 adjacent orientation-transmitting layers; and

(c) a crystalline active layer;

wherein said 0 to 10 orientation-transmitting layers are adjacent said nucleating surface and are adjacent said active layer, whereby said active layer is oriented in registry with said nucleating surface.

add B1